LTCC SURFACE MOUNT

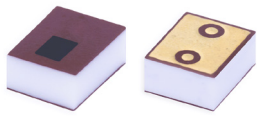
High Pass Filter

HFHK-2000+

50Ω 2100 to 9500 MHz

THE BIG DEAL

- Insertion Loss, Typ. 0.7 dB
- Stopband Rejection, Typ. 74 dB
- Passband Return Loss, Typ. 18 dB
- 1008 Surface Mount Footprint
- Power Handling: 6 W
- Shielded Construction: Prevents De-Tuning & EMI
- Protected by US Patents 11,638,370 and 11,744,057

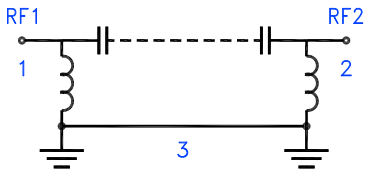


Generic photo used for illustration purposes only

APPLICATIONS

- 5G Sub- 6 GHz
- Radar, EW, ECM Defense Systems
- Test and Measurement Equipment
- Telecommunications and Broadband Wireless Systems
- WiFi 6E

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

Mini-Circuits' HFHK-2000+ is a miniature low temperature co-fired ceramic (LTCC) high pass filter with a 2100 to 9500 MHz passband that supports a variety of applications. This model provides 0.7 dB typical insertion loss over a wide band due to its rugged monolithic construction. Housed in a small 1008 ceramic form factor, the filter is ideal for dense signal chain PCB layouts where it complements MMIC size and performance. The LTCC fabrication process assures minimal RF performance variation while delivering a product that is well suited for environmental extremes of high humidity and temperature.

KEY FEATURES

Features	Advantages
Wide Passband, 7.4 GHz	This filter has a very wide passband from, 2100 to 9500 MHz.
LTCC Construction	Provides repeatable performance in a rugged, ceramic package well suited for tough environments such as high humidity and temperature extremes.
Small Size, 1008	Saves space in dense circuit board layouts and minimizes the effects of parasitics.
Rugged Power Handling, 6 Watts	Handles up to 6 Watts in a small 1008 package.
Shielded Construction	Due to the novel construction, it is immune to EMI/EMC effects with other neighboring components/ devices.

REV. A
ECO-026124
HFHK-2000+
EDU4871
URJ
250703

High Pass Filter

HFHK-2000+

50Ω 2100 to 9500 MHz

ELECTRICAL SPECIFICATIONS[1,2,3] AT +25°C

Parameter		F#	Frequency (MHz)	Min.	Typ.	Max.	Units
Passband	Insertion Loss	F4-F5	2100 - 3300	—	1.2	2.3	dB
		F5-F6	3300 - 8000	—	0.7	1.5	
		F6-F7	8000 - 9500	—	0.8	2.5	
	Return Loss	F4-F5	2100 - 3300	—	17	—	dB
		F5-F6	3300 - 8000	10	18	—	
		F6-F7	8000 - 9500	—	18	—	
Stopband	Rejection	DC-F1	DC - 550	67	74	—	dB
		F1-F2	550 - 1000	40	52	—	
		F2-F3	1000 - 1350	20	32	—	
	Freq. Cut-Off[4]	Fc	1850	—	3	—	dB

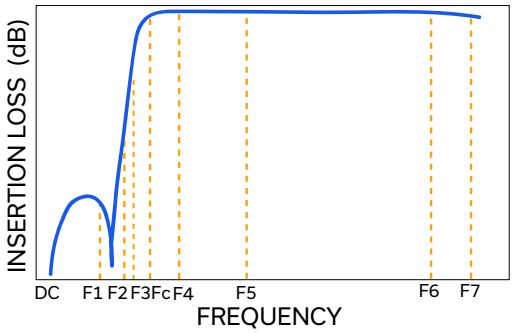
1. Tested on Evaluation Board P/N TB-HFHK-2000+ with connectors and feedline de-embedded with thru-line compensation.
2. This filter is bi-directional RF1 and RF2 ports may be interchanged. See S-Parameters for actual performance.
3. This component should not be used as a DC-block. In applications where DC voltage and/or current is present at either the input or output ports, external DC blocking capacitors are required.
4. Typical variation ±5%.

ABSOLUTE MAXIMUM RATINGS[5]

Parameter	Ratings
Operating Temperature	-55°C to +125°C
Storage Temperature	-55°C to +125°C
Input Power[6]	6 W @ +25°C

5. Permanent damage may occur if any of these limits are exceeded.
6. Power rating applies only to signals within the passband. Power rating above +25°C operating temperature decreases linearly to 1 W at +125°C.

TYPICAL FREQUENCY RESPONSE AT +25°C

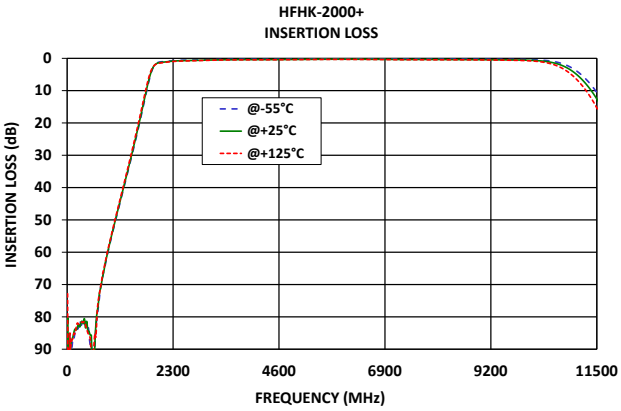


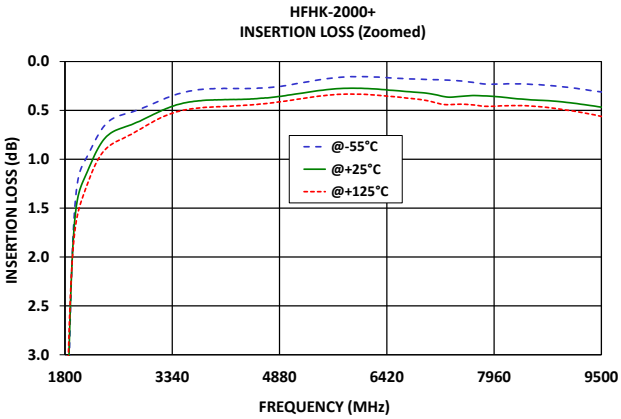
High Pass Filter

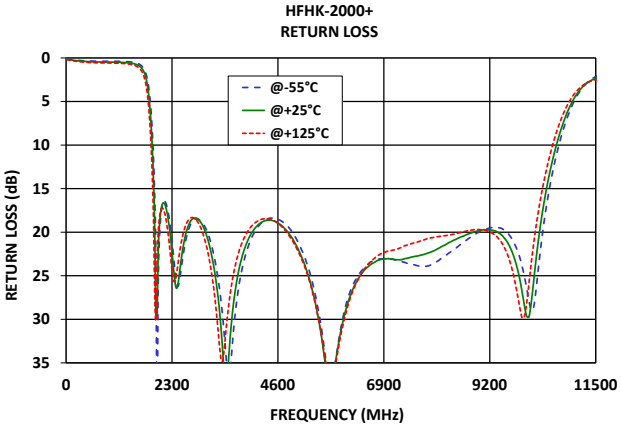
HFHK-2000+

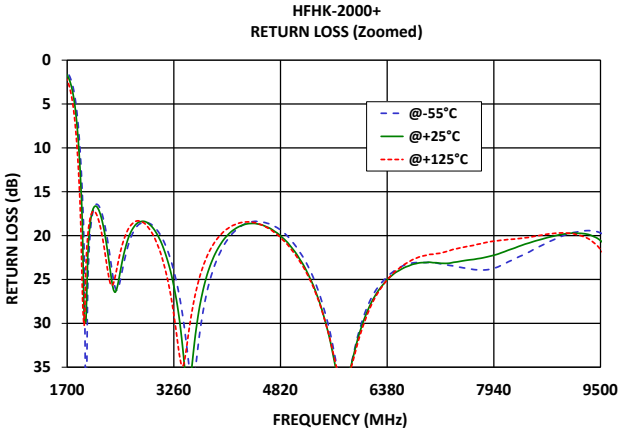
50Ω 2100 to 9500 MHz

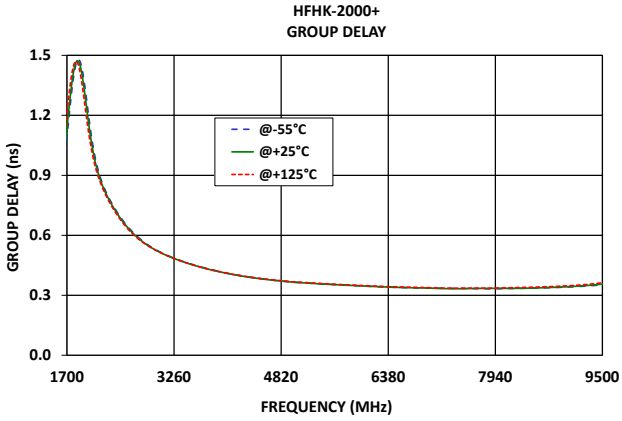
TYPICAL PERFORMANCE GRAPHS











High Pass Filter

HFHK-2000+

50Ω 2100 to 9500 MHz

FUNCTIONAL DIAGRAM

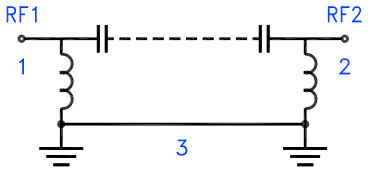
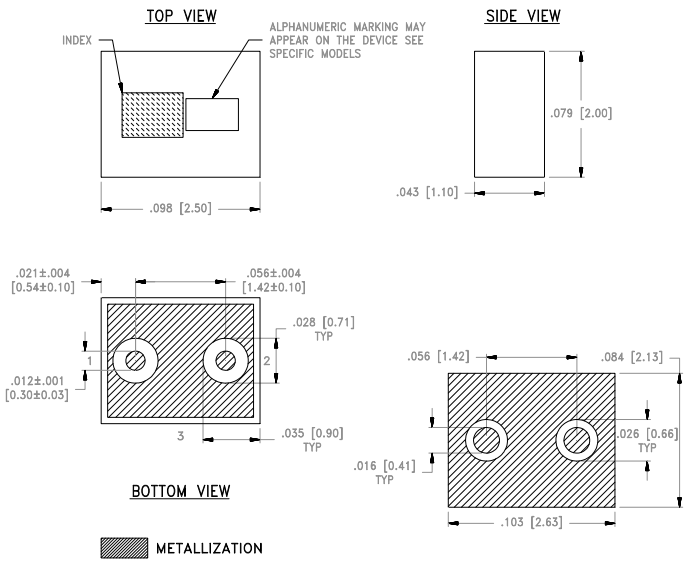


Figure 1. HFHK-2000+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
RF1[2]	1	Connects to RF Input Port
RF2[2]	2	Connects to RF Output Port
GROUND	3	Connects to Ground on PCB, (See drawing PL-798)
NC	—	No connection, not used internally. See drawing PL-798 for connection to PCB

CASE STYLE DRAWING



Weight: .019 grams.
Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3Pl. ± .005

PRODUCT MARKING*: H8

*Marking may contain other features or characters for internal lot control.

High Pass Filter

HFHK-2000+

50Ω 2100 to 9500 MHz

SUGGESTED PCB LAYOUT (PL-798)

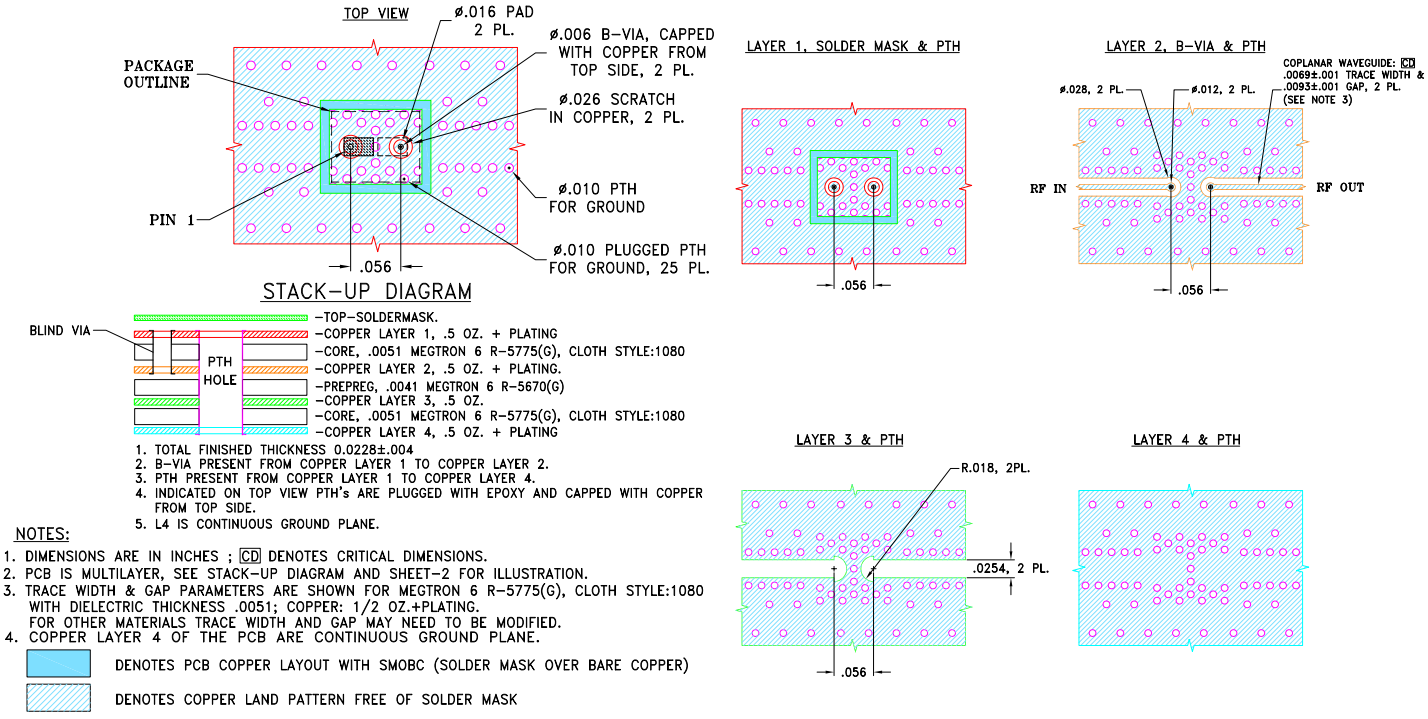


Figure 2. Suggested PCB Layout PL-798

High Pass Filter

HFHK-2000+

50Ω 2100 to 9500 MHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD. CLICK HERE

Performance Data and Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads
Case Style	NL1008C-10 Lead Finish: Gold over Electroless Nickel
RoHS Status	Compliant
Tape and Reel	TR-F75
Suggested Layout for PCB Design	PL-798
Evaluation Board	TB-HFHK-2000+
	Gerber File
Environmental Rating	ENV06T10

NOTES

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits' standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full staement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html

Ceramic High Pass Filter HFHK-2000+

Typical Performance Data

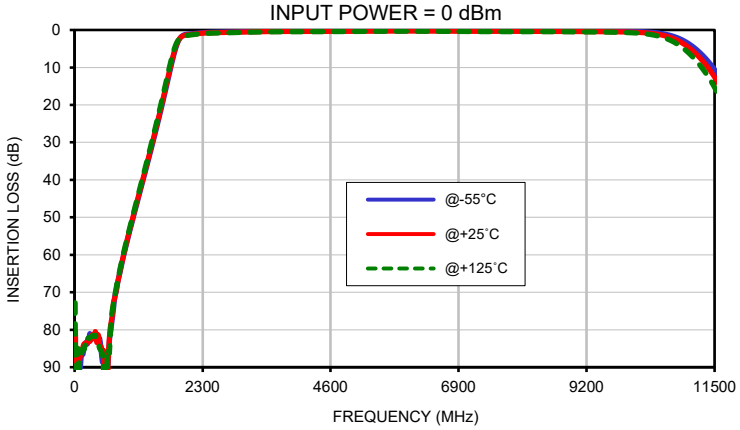
FREQ.	INSERTION LOSS			INPUT RETURN LOSS			OUTPUT RETURN LOSS		
(MHz)	(dB)			(dB)			(dB)		
	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C	@-55°C	@+25°C	@+125°C
10	87.21	81.89	72.83	0.10	0.14	0.18	0.11	0.15	0.20
20	88.45	88.73	95.49	0.11	0.15	0.20	0.12	0.16	0.21
30	105.69	85.32	97.14	0.12	0.16	0.21	0.13	0.17	0.22
40	96.25	88.23	100.80	0.12	0.17	0.22	0.14	0.18	0.24
50	88.79	90.17	89.84	0.13	0.18	0.23	0.15	0.19	0.25
60	88.52	97.23	84.98	0.14	0.19	0.24	0.15	0.20	0.26
70	93.92	96.81	90.26	0.15	0.20	0.25	0.16	0.21	0.27
100	90.20	87.13	87.27	0.17	0.22	0.27	0.19	0.24	0.30
150	86.60	84.57	85.02	0.21	0.26	0.32	0.23	0.28	0.34
300	82.57	81.81	81.77	0.29	0.35	0.43	0.31	0.38	0.46
400	81.43	83.43	82.61	0.32	0.39	0.48	0.35	0.42	0.51
550	96.10	97.42	92.63	0.35	0.43	0.53	0.38	0.46	0.56
700	74.22	72.63	72.98	0.37	0.46	0.56	0.39	0.48	0.58
800	65.62	65.70	65.00	0.37	0.47	0.57	0.39	0.48	0.58
900	59.13	58.73	58.25	0.38	0.47	0.58	0.39	0.48	0.58
1000	53.10	52.79	52.24	0.38	0.48	0.59	0.39	0.48	0.59
1200	41.79	41.35	40.70	0.39	0.51	0.62	0.40	0.50	0.62
1350	33.30	32.79	32.03	0.43	0.56	0.69	0.44	0.56	0.69
1500	24.48	23.90	23.00	0.54	0.70	0.88	0.56	0.72	0.89
1650	15.08	14.43	13.40	0.96	1.23	1.60	1.00	1.26	1.61
1750	8.64	8.05	7.15	2.11	2.67	3.58	2.13	2.66	3.52
1850	3.46	3.25	2.98	6.50	8.01	10.60	6.33	7.68	9.90
1900	2.06	2.08	2.09	11.77	14.35	19.03	11.06	13.01	15.91
2000	1.17	1.34	1.51	26.16	22.49	20.11	20.84	19.76	18.82
2100	1.00	1.16	1.30	16.68	16.69	17.25	16.99	17.13	17.91
2200	0.86	1.00	1.11	17.28	17.97	19.57	18.40	19.29	21.57
2400	0.63	0.76	0.88	25.89	26.45	24.74	36.75	34.64	28.29
2500	0.58	0.71	0.83	24.21	23.13	21.20	25.83	24.21	21.93
2700	0.53	0.66	0.76	19.15	18.76	18.38	19.52	19.31	18.85
2900	0.48	0.60	0.68	18.60	18.70	19.23	19.18	19.53	19.97
3000	0.45	0.57	0.64	19.23	19.65	20.65	19.99	20.68	21.61
3300	0.36	0.47	0.54	25.31	27.43	31.23	26.65	29.07	33.01
3500	0.32	0.42	0.50	35.98	36.61	29.83	38.37	38.03	30.57
3700	0.29	0.40	0.48	28.10	25.79	23.23	29.60	27.50	24.48
4000	0.28	0.39	0.46	20.99	20.35	19.48	22.50	22.14	20.94
4500	0.27	0.38	0.44	18.39	18.69	18.66	19.32	19.69	19.51
4600	0.27	0.38	0.43	18.53	18.94	18.99	19.22	19.64	19.56
4800	0.26	0.36	0.42	19.25	19.88	20.07	19.36	19.86	19.97
5000	0.24	0.34	0.40	20.78	21.54	21.80	20.21	20.65	20.88
5200	0.22	0.32	0.38	23.15	24.01	24.24	21.76	22.10	22.39
5400	0.19	0.30	0.36	26.91	27.81	27.93	24.32	24.50	24.86
5600	0.17	0.28	0.34	33.12	34.04	33.72	28.36	28.43	28.86
5800	0.16	0.27	0.33	36.39	36.43	36.38	32.23	32.75	33.02
6000	0.15	0.27	0.33	30.10	30.50	30.95	28.86	30.05	30.13
6400	0.16	0.29	0.35	24.53	24.87	24.85	22.92	23.44	23.35
6800	0.18	0.31	0.38	23.08	23.20	22.59	21.37	21.50	21.09
7000	0.18	0.32	0.40	23.06	23.03	22.14	21.55	21.40	20.78
7500	0.20	0.36	0.44	23.68	22.86	21.32	23.36	22.01	21.07
8000	0.23	0.36	0.46	23.57	22.10	20.58	24.82	23.46	22.14
8100	0.23	0.37	0.45	23.21	21.82	20.49	24.93	23.54	22.12
8300	0.23	0.38	0.45	22.44	21.24	20.34	24.85	23.41	21.96
8400	0.23	0.39	0.45	22.08	20.96	20.24	24.58	23.18	21.81
8500	0.23	0.39	0.46	21.68	20.72	20.13	24.12	22.87	21.60
8600	0.24	0.40	0.46	21.27	20.50	19.99	23.53	22.49	21.36
8700	0.24	0.40	0.47	20.89	20.28	19.86	22.87	22.04	21.08
9000	0.26	0.42	0.50	19.88	19.78	19.71	21.00	20.78	20.44
9100	0.27	0.43	0.51	19.65	19.71	19.78	20.48	20.50	20.37
9200	0.28	0.44	0.52	19.52	19.74	19.98	20.05	20.33	20.41
9400	0.30	0.46	0.55	19.49	20.11	20.80	19.56	20.37	20.98
9500	0.31	0.47	0.56	19.70	20.57	21.59	19.58	20.70	21.67

Typical Performance Data

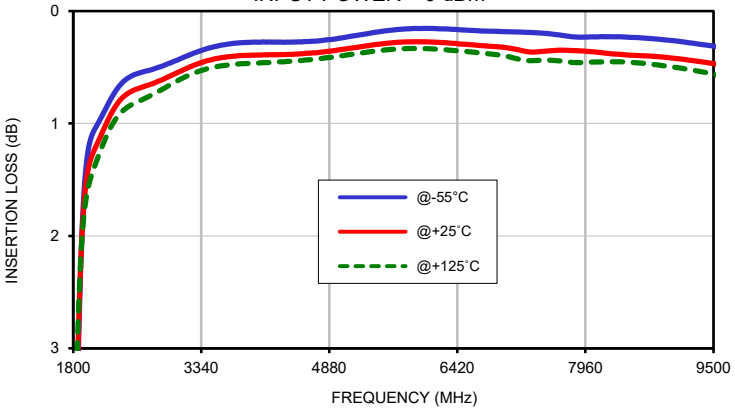
FREQ. (MHz)	GROUP DELAY (nsec)		
	@-55°C	@+25°C	@+125°C
2100	1.01	0.99	0.96
2500	0.68	0.68	0.67
3000	0.53	0.52	0.52
3200	0.49	0.49	0.49
3300	0.48	0.48	0.48
3500	0.46	0.46	0.46
3800	0.43	0.43	0.43
4000	0.41	0.41	0.41
4200	0.40	0.40	0.40
4400	0.39	0.39	0.39
4600	0.38	0.38	0.38
4800	0.37	0.37	0.37
5000	0.37	0.37	0.37
5200	0.36	0.36	0.36
5400	0.36	0.36	0.36
5600	0.35	0.35	0.36
5800	0.35	0.35	0.35
6000	0.35	0.35	0.35
6200	0.34	0.34	0.35
6400	0.34	0.34	0.34
6600	0.34	0.34	0.34
6800	0.34	0.34	0.34
7000	0.34	0.34	0.34
7200	0.33	0.33	0.34
7400	0.33	0.33	0.34
7600	0.33	0.33	0.34
7800	0.33	0.33	0.34
8000	0.33	0.33	0.34
8100	0.33	0.33	0.34
8200	0.33	0.33	0.34
8300	0.33	0.33	0.34
8400	0.34	0.34	0.34
8500	0.34	0.34	0.34
8600	0.34	0.34	0.34
8700	0.34	0.34	0.34
9000	0.34	0.34	0.35
9100	0.34	0.34	0.35
9200	0.34	0.35	0.35
9400	0.35	0.35	0.36
9500	0.35	0.36	0.36

Typical Performance Curves

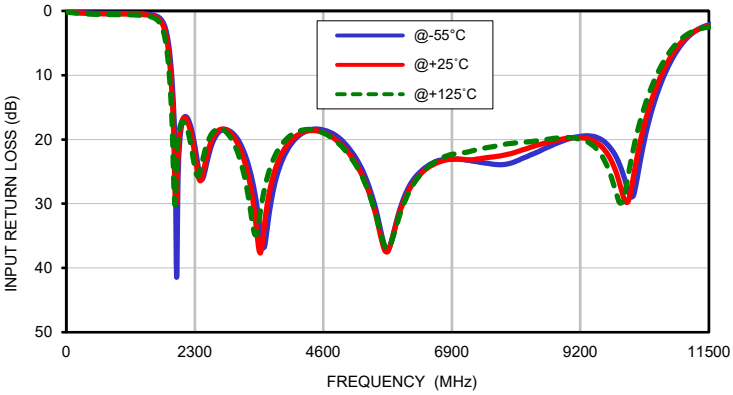
INSERTION LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



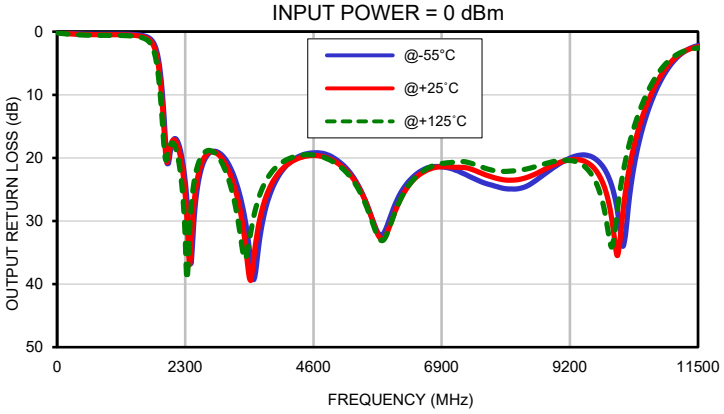
INSERTION LOSS vs. TEMPERATURE (Zoomed)
INPUT POWER = 0 dBm



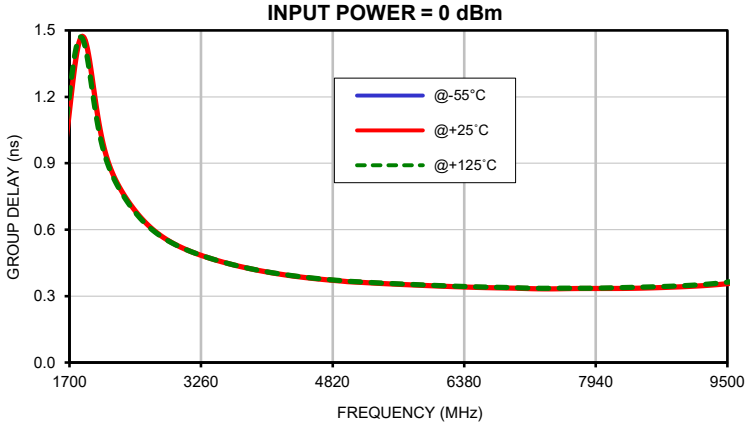
INPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm



OUTPUT RETURN LOSS vs. TEMPERATURE
INPUT POWER = 0 dBm

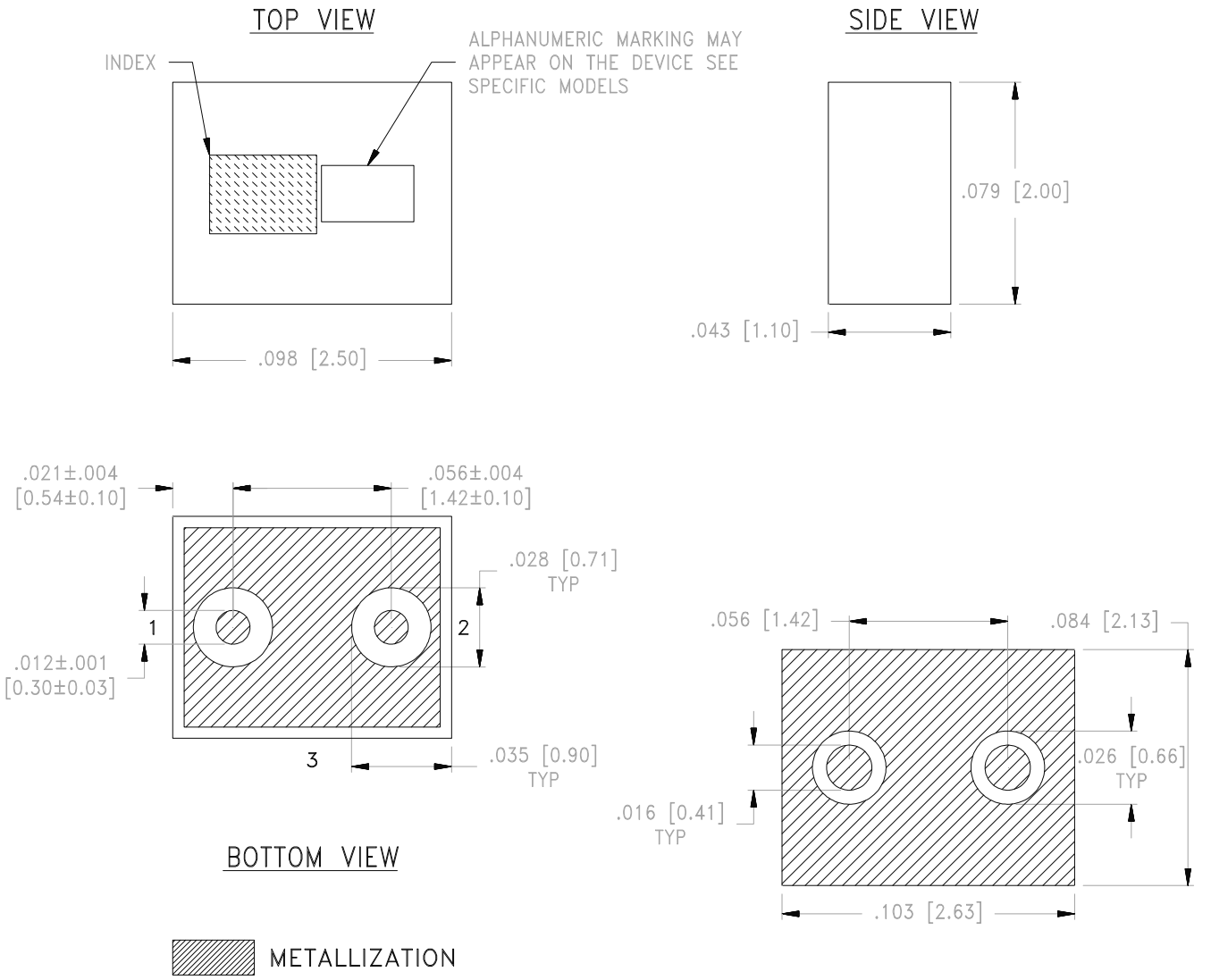


GROUP DELAY vs. TEMPERATURE
INPUT POWER = 0 dBm



Case Style NL

Outline Dimensions NL1008C-10



SUGGESTED LAYOUT FOR PCB LAND PATTERN

PATTERN TO BE WITHIN ±.002

Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3Pl. ± .005

Notes:

1. Open style, Ceramic base.
2. Termination finish: **as shown below or indicated on Data sheet.**
   For RoHS Case Styles: Gold plate over nickel plate. All models, (+) suffix.
3. Weight: .019 grams.
4. Pad tolerance is non-cumulative.

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Tape & Reel Packaging TR-F75

DEVICE ORIENTATION IN T&R

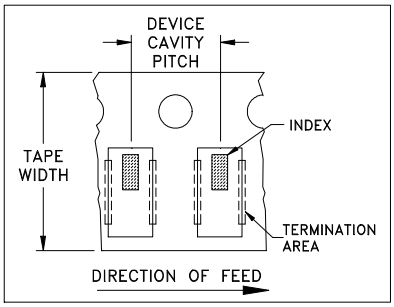

ILLUSTRATION 1

Applicable Case Styles
FV1206-1
FV1206-3

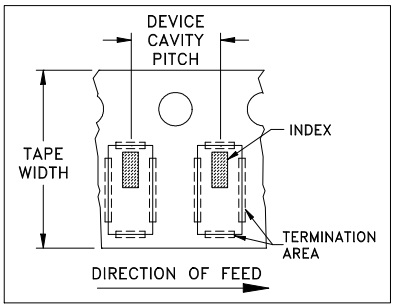

ILLUSTRATION 2

Applicable Case Styles
FV1206-4
FV1206-5
FV1206-6
FV1206-7
FV1206-9

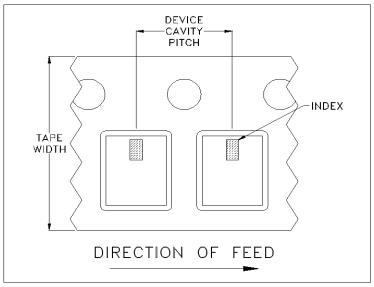

ILLUSTRATION 3

Applicable Case Styles
FV1206-11
FV1206-12
GE0805C-18
NL1008C-6
NL1008C-7
NL1008C-9
NL1008C-10
NL1008C-12

Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
8	4	7	Small quantity standards (see note)	20
				50
				100
				200
				500
				1000
			Standard	3000

Note: Please consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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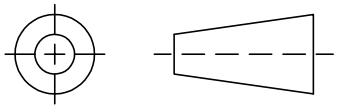
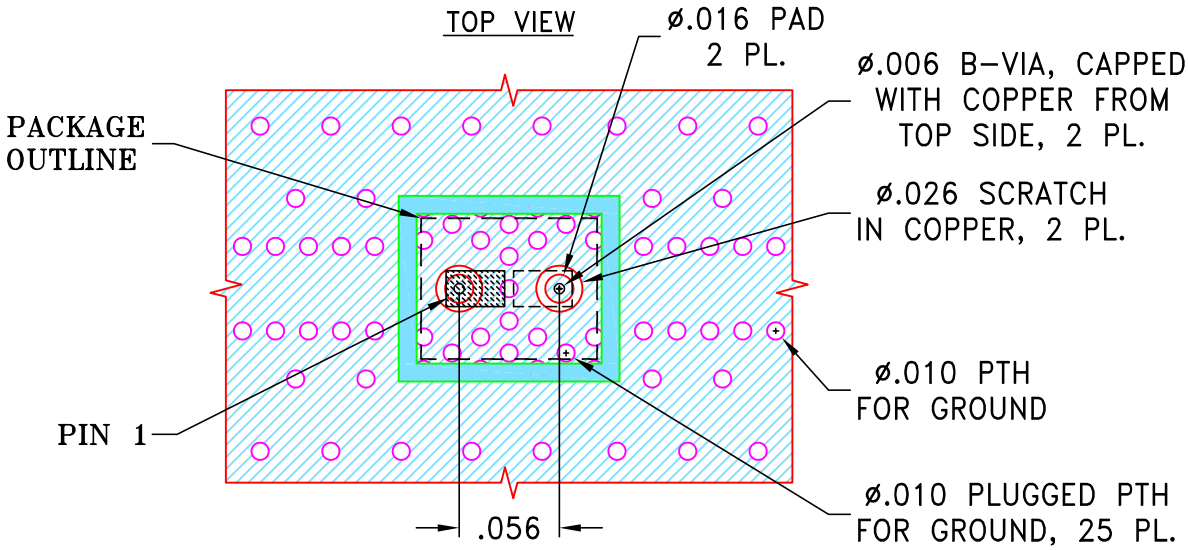
THIRD ANGLE PROJECTION

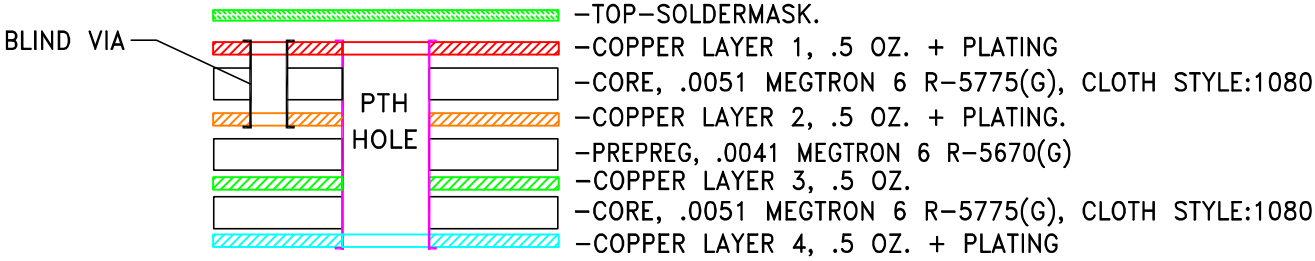


REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-023057	NEW RELEASE	SEP 24	AGS	GT
OR1	NPO-004738	ADDED NL1008C-10 CASE STYLE	OCT 24	AGS	GT
OR2	ECO-023820	NOTES & TOLERANCES UPDATED	NOV 24	AGS	GT

SUGGESTED MOUNTING CONFIGURATION FOR NL1008C-9,NL1008C-10 CASE STYLE



STACK-UP DIAGRAM



1. TOTAL FINISHED THICKNESS 0.0228±.004
2. B-VIA PRESENT FROM COPPER LAYER 1 TO COPPER LAYER 2.
3. PTH PRESENT FROM COPPER LAYER 1 TO COPPER LAYER 4.
4. INDICATED ON TOP VIEW PTH's ARE PLUGGED WITH EPOXY AND CAPPED WITH COPPER FROM TOP SIDE.
5. L4 IS CONTINUOUS GROUND PLANE.

NOTES:

1. DIMENSIONS ARE IN INCHES ; CD DENOTES CRITICAL DIMENSIONS.
2. PCB IS MULTILAYER, SEE STACK-UP DIAGRAM AND SHEET-2 FOR ILLUSTRATION.
3. TRACE WIDTH & GAP PARAMETERS ARE SHOWN FOR MEGTRON 6 R-5775(G), CLOTH STYLE:1080 WITH DIELECTRIC THICKNESS .0051; COPPER: 1/2 OZ.+PLATING. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
4. COPPER LAYER 4 OF THE PCB ARE CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	AGS	14 SEP 24
TOLERANCES ON:	CHECKED	MD	16 SEP 24
2 PL DECIMALS ±	APPROVED	GTP	17 SEP 24
3 PL DECIMALS ± .002			
ANGLES ±			
FRACTIONS ±			

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ASHEETA1.DWG REV:A DATE:01/12/95

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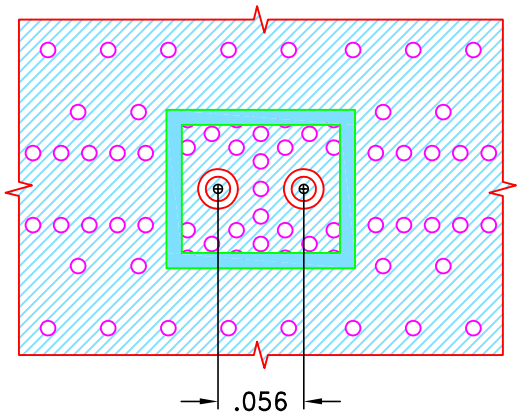
PL, NL1008C-9/10, TB-LFHK-XXXX+

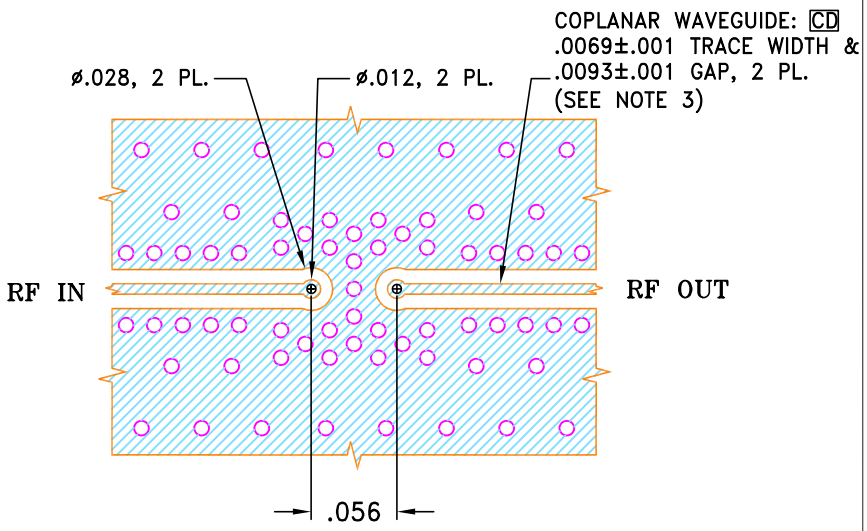
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-798	OR2

FILE:	SCALE:	SHEET:
98-PL-798	9:1	1 OF 2

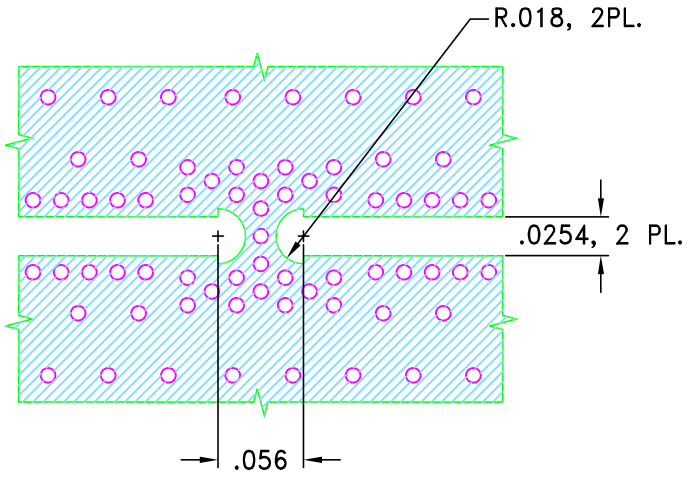
LAYER 1, SOLDER MASK & PTH



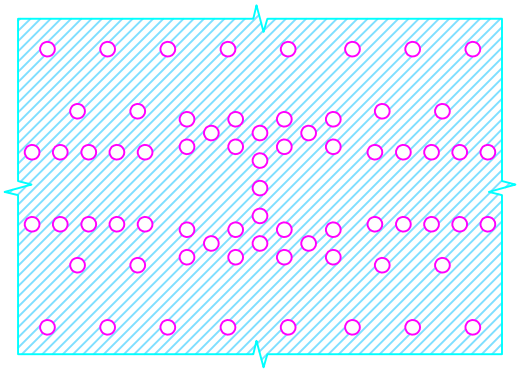
LAYER 2, B-VIA & PTH



LAYER 3 & PTH



LAYER 4 & PTH



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ASHEETA2.DWG REV:A DATE: 01/12/94

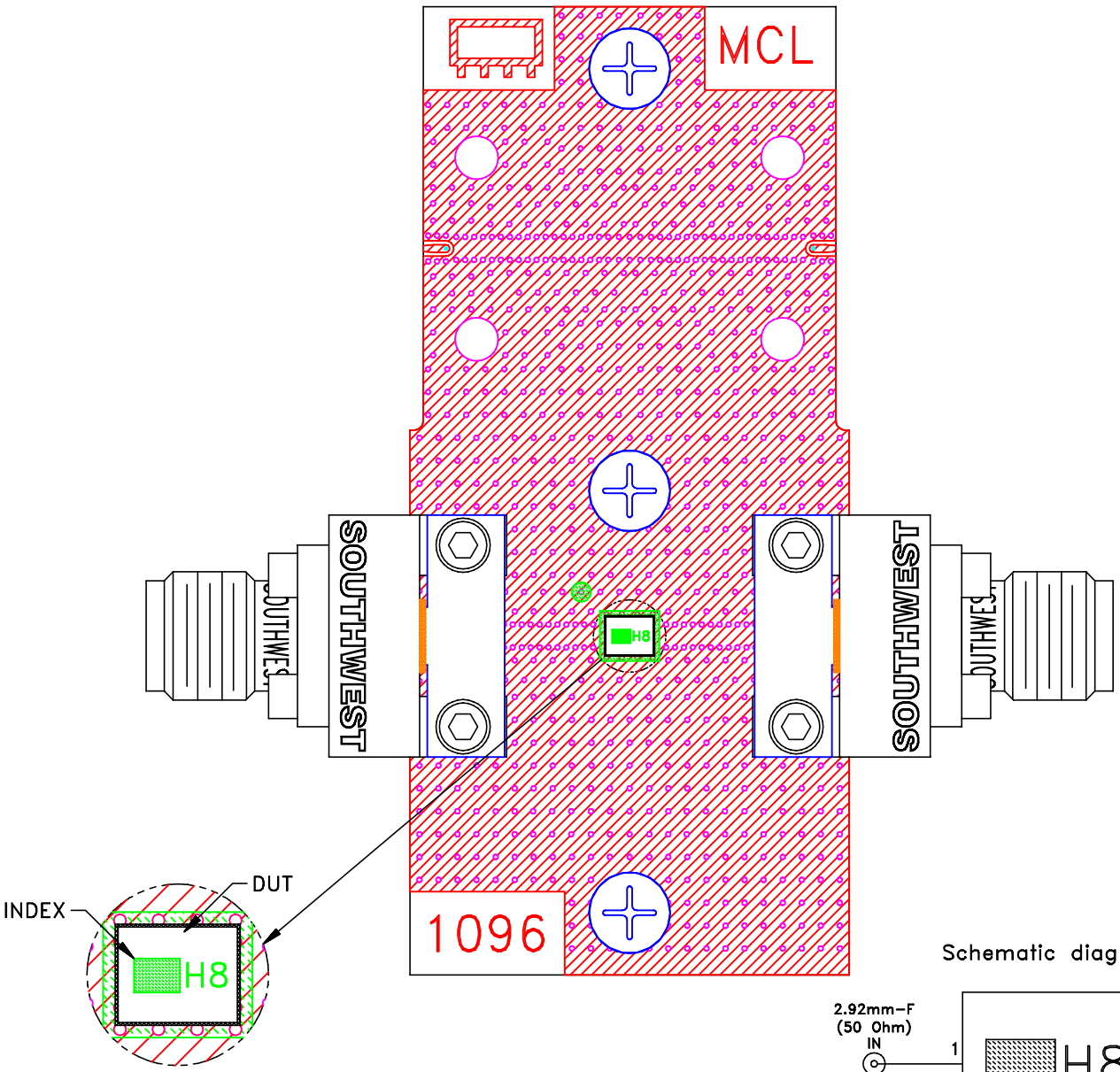
ALL DIMENSIONS ARE IN INCHES EXCEPT OTHERWISE SPECIFIED

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-798	0R2

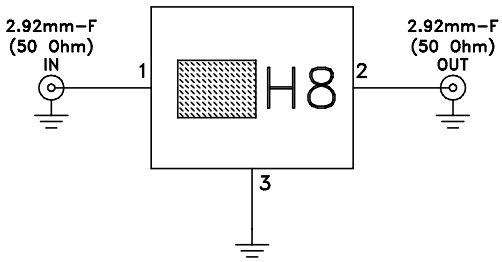
FILE:	SCALE:	SHEET:
98-PL-798	7.7:1	2 OF 2

Evaluation Board and Circuit

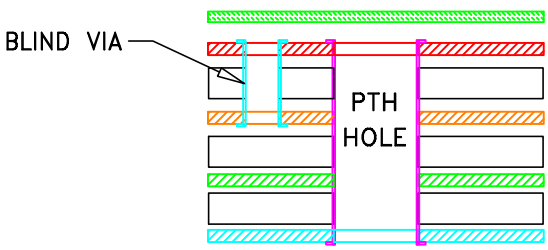
TB-HFHK-2000+



Schematic diagram



STACK-UP DIAGRAM



-TOP-SOLDERMASK.
-COPPER LAYER 1, .5 OZ. + PLATING
-CORE, .0051 MEGTRON 6 R-5775(G), CLOTH STYLE:1080
-COPPER LAYER 2, .5 OZ. + PLATING.
-PREPREG, .0041 MEGTRON 6 R-5670(G)
-COPPER LAYER 3, .5 OZ.
-CORE, .0051 MEGTRON 6 R-5775(G), CLOTH STYLE:1080
-COPPER LAYER 4, .5 OZ. + PLATING

Notes:

1. PCB Material: MEGTRON-6 R5775(G) OR Equivalent, Dielectric Constant=3.6
2. Total finished thickness: .023
3. 50 Ohm 2.92mm Female End Launch Connector.

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Environmental Specifications ENV06T10

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Solder Reflow Heat	Sn-Pb Eutectic Process 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020C, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, Test B,B1, 95% Coverage
Thermal Shock	-55° to +125°C, 15 min dwell,250 cycles	MIL-STD-202, Method 107
Bend Test	1mm, deflection for 5 seconds Span of bending: 2.75"	--
High Temp Storage	125°C to 1000 Hrs	---

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